

# UWM Innovation Campus Storm Water Management BMPs

Waukesha County Storm Water Workshop

March 20, 2019

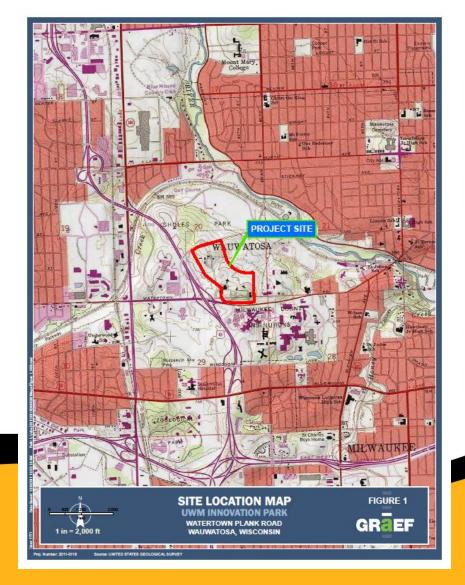
John T. McCarthy, P.E., LEED AP







# UWM Innovation Campus City of Wauwatosa







# Innovation Campus – GRAEF Planning for the Future of UWM

- 2008 UWM Campus Master Plan
- Graduate Engineering Campus in Wauwatosa
- Opportunities for Synergies with the Milwaukee Regional Medical Center





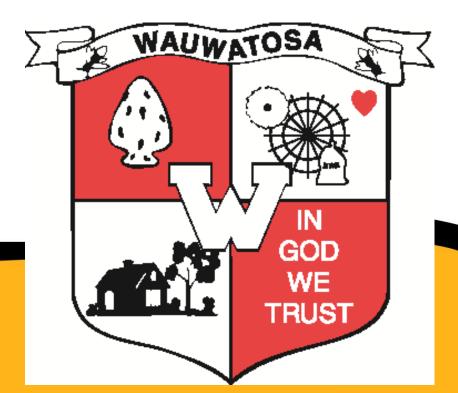




#### **Project Partners**

- UWM Real Estate Foundation
- City of Wauwatosa

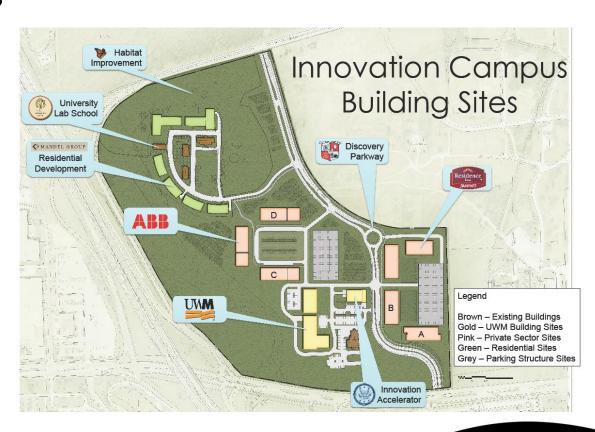




#### **UWM Innovation Campus**



- Echelon Campus
- UWM Innovation Accelerator
- ABB
   Development
- Marriot
   Residence Inn
- MKE Parks
   Administration
   Building









#### Pre-Development Site – NE Quad of the MCG







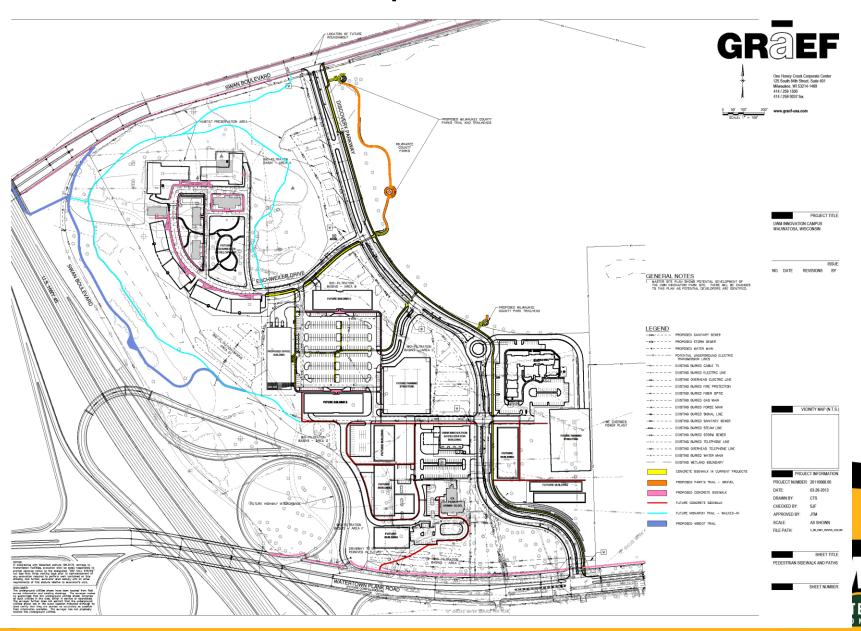






#### UWM Innovation Campus Master Plan GRaEF

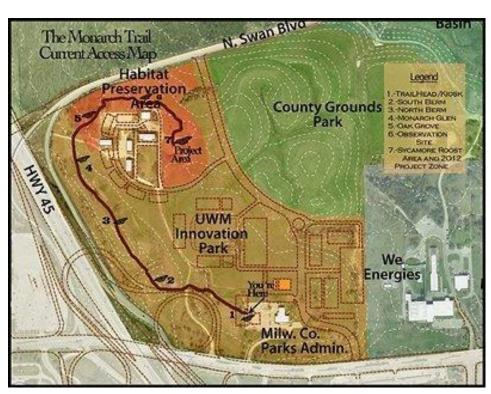






#### Project Challanges

- Monarch Butterfly Habitat
- WisDOT Interchange Work
- We Energies Steam Lines
- Historic and Archaeological Issues
- Milwaukee County Utilities
- ATC Transmission Lines
- Milwaukee County Parks
- Storm Water Management







# Storm Water Management Challanges



- "Zero Discharge" Design Criteria
- No Open Water Ponds
- No Underdrain Discharge Allowed to Milwaukee County Parks
- Poor Infiltration Capacity





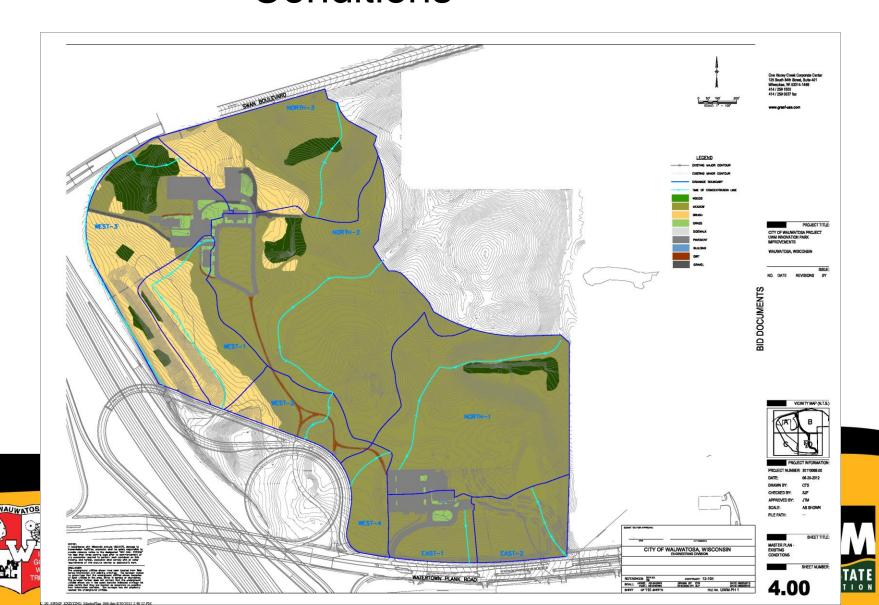
## Green Infrastructure Components

- Twenty Two Bio-Filtration Basins
- Two Areas of Permeable Pavement
- Additional Future BMPs



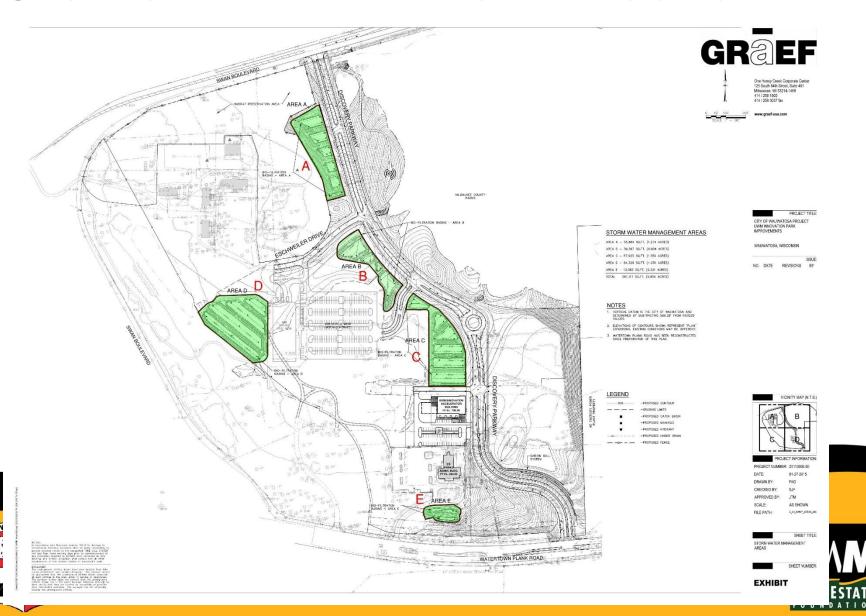
#### Storm Water Management– Existing GRaEF **Conditions**





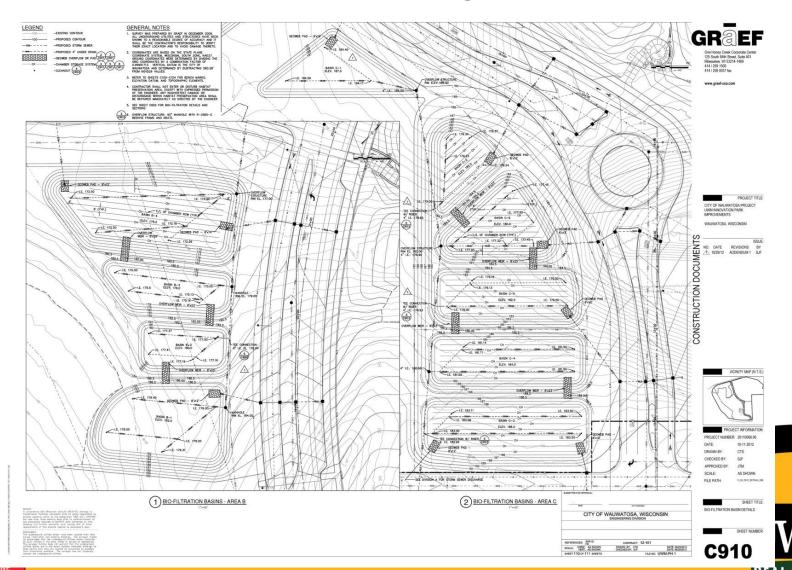
#### GRäEF

#### Site Plan with Bio-Filtration Basins



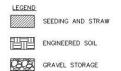


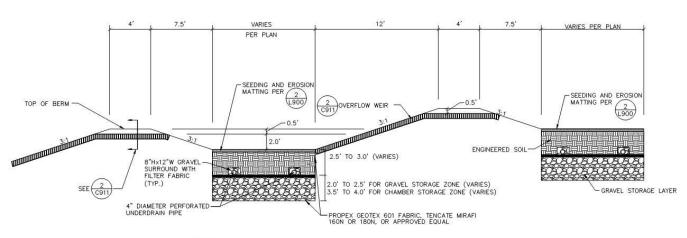
#### Basin Grading Plans





#### **Basin X-Section**





NOTES:

1. VARY DEPTH OF ENGINEERED SOIL LAYER AND GRAVEL STORAGE OR CHAMBER STORAGE LAYER BASED ON SLOPE OF UNDERDRAIN SYSTEM AS SHOWN ON PLANS AND IN BIO-FILTRATION BASIN DATA TABLE.



**BIO-FILTRATION TYPICAL SECTION** 

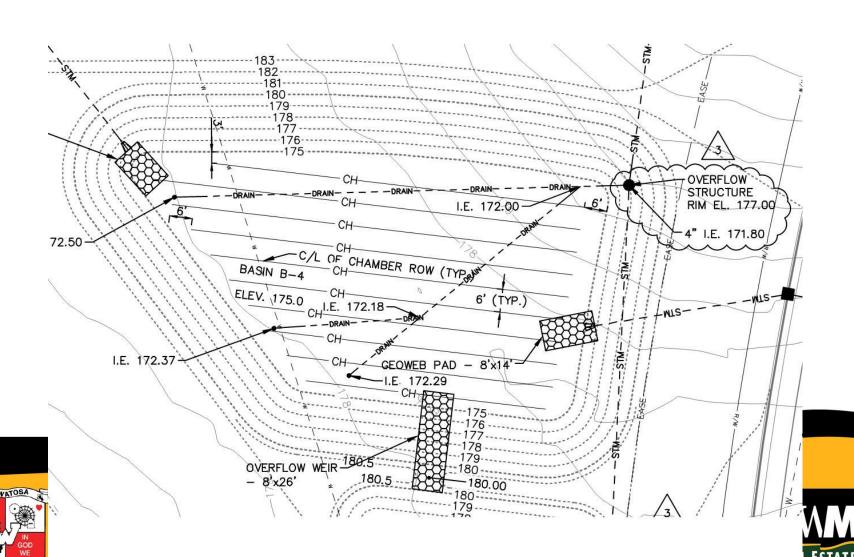








#### Bio-Basin B-4 Plan



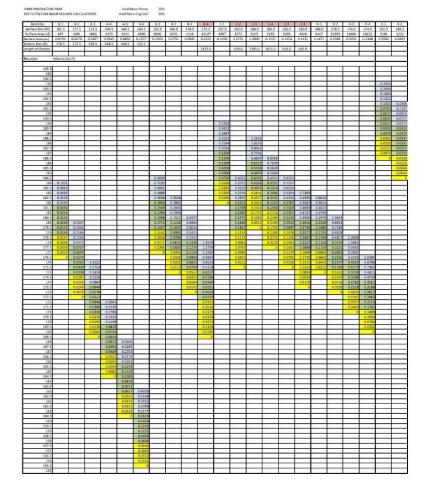


#### Bio-Basin B-4





# Basin Depth/Storage Calcs









#### Basin Depth/Storage Calcs

Basin No.	A-1	A-2	A-3	A-4		
Surface Elev (Ft)	181.5	177.5	173.5	169.5		
Surface Area (sf)	847	2081	1860	2375		
Surface Area (ac)	0.0194	0.0478	0.0427	0.0545		
Bottom Elev (ft)	176.5	172.5	168.5	164.5		
Length of Chmbrs						
Elevation Volume (Ac-ft)						
195.5						
195						
194.5						
194						
193.5						







# Basin Depth Storage Calcs

			S .	20	
180.5	0.0233				
180	0.0204	0.2347			
179.5	0.0175	0.1945			0
179	0.0146	0.1584			
178.5	0.0117	0.1260			0
178	0.0088	0.0972			
177.5	0.0058	0.0717			
177	0.0029	0.0645			
176.5	0	0.0573			
176		0.0502	0.2122		0
175.5		0.0430	0.1754		
175		0.0358	0.1424		
174.5		0.0287	0.1130		2
174		0.0215	0.0869		
173.5		0.0143	0.0640		
173		0.0072	0.0576		
172.5		0	0.0512		
172			0.0448	0.2643	8
171.5			0.0384	0.2199	
171			0.0320	0.1796	







#### Bio-Basin System A





#### Basin Underdrain Depth/Discharge Calcs

Basin No.	A-1	A-2	A-3	A-4	A-5	A-6
Bottom Elev (Ft)	176.5	172.5	168.5	164.5	160.5	155.5
UD Invrt Elev (Ft)	178.5	174.5	170.5	166.5	162.5	157.5
Surface Elev (Ft)	181.5	177.5	173.5	169.5	165.5	160.5
Weir Elev (Ft)	183.5	179.5	175.5	171.5	167.5	162.5
Berm Elev (Ft)	184.0	180.0	176.0	172.0	168.0	163.0
Ovrflw Width (Ft)	4	4	4	4	4	12
Outlet Diam (In)	4	4	4	4	4	4
Outlet Length (Ft)	12	20	14	24	22	30
H at Surface (Ft)	3	3	3	3	3	3
H at Weir (Ft)	5	5	5	5	5	5
H at Berm (Ft)	5.5	5.5	5.5	5.5	5.5	5.5
"k"	3.619333	3.619333	3.619333	3.619333	3.619333	3.619333
Q at Bottom (cfs)	0	0	0	0	0	0
Q at UD invrt (cfs)	0	0	0	0	0	0
Q at Surface (cfs)	0.951	0.737	0.881	0.673	0.703	0.602
Q at Weir (cfs)	1.228	0.951	1.137	0.868	0.907	0.777
Q at Berm (cfs)	6.050	5.759	5.954	5.672	5.713	15.100







#### **Basin Infiltration Calcs**

Basin	Infiltration Rate (in/hr)	Infiltration Rate (ft/sec)	Basin Area (sqft)	Constant Infiltration (cfs)
A-1	0.13	3.00926E-06	847	0.003
A-2	0.13	3.00926E-06	2080	0.006
A-3	0.03	6.94444E-07	1859	0.001
A-4	0.03	6.94444E-07	2375	0.002
A-5	0.03	6.94444E-07	3640	0.003
A-6	0.03	6.94444E-07	4689	0.003





#### Basin Elevation Data



	BIO-FILTRATION BASIN DATA								
				ELF	EVATION - FEET	Т			
				ENGINEERED	STORAGE		7		
	BASIN	1	1	SOIL	LAYER		'		
SYSTEM	NO.	BASIN TYPE	SURFACE	(BOTTOM)	(BOTTOM)	BERM	OVERFLOW	TYPE	
^	^ 1	GRAVEL	101 50	MAX: 178.75	176 FO	104.00	102 50	WEID	
Α	A-1	STORAGE	181.50	MIN: 178.50	176.50	184.00	183.50	WEIR	
۸	GRAVEL	GRAVEL	177.50	MAX: 174.75	172.50	100.00	170.50	WEID	
Α	A-2	STORAGE	177.50	MIN: 174.50	172.50	180.00	179.50	WEIR	
٨	L A-3	GRAVEL	470 50	MAX: 170.73	150 50	176.00	475 50	WEID	
Α		STORAGE	173.50	MIN: 170.50	168.50	176.00	175.50	WEIR	
^		GRAVEL	100 50	MAX: 166.80	154.50	472.00	474 50	WEID	
Α	A-4	STORAGE	169.50	MIN: 166.50	164.50	172.00	171.50	WEIR	





#### **Basin Excavation**





#### Geotextile Liner







#### Aggregate Storage Layer



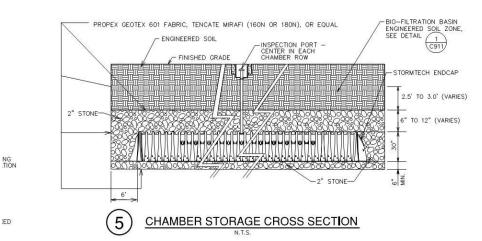


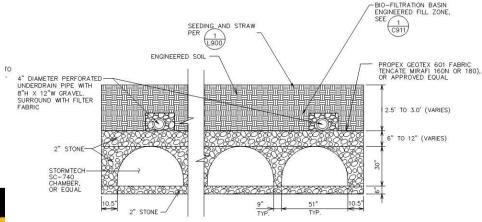




#### Storm Tech ® Chambers GRaEF







CHAMBER STORAGE CROSS SECTION







#### Infiltration Chamber Installation

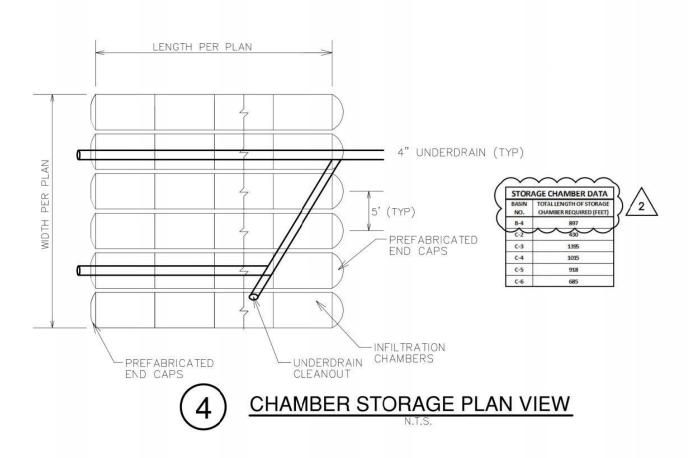






#### Storm Tech ® Chambers GRaEF











#### Infiltration Chamber Installation

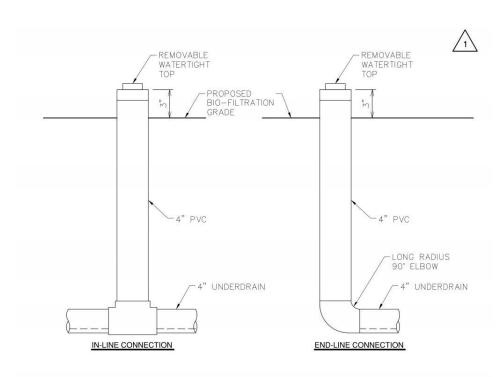






#### Underdrain Clean-out





NOTE: USE 6" PVC CLEANOUT FOR 6" HDPE UNDERDRAIN COLLECTORS IN BIO— FILTRATION AREAS D AND E.









### GRaEF Geotextile and Underdrain with Cleanout





#### Geotextile, Underdrain, and Engineered Soil



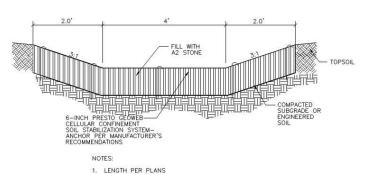
# Basins in Various Stages – June 2013 GRāEF



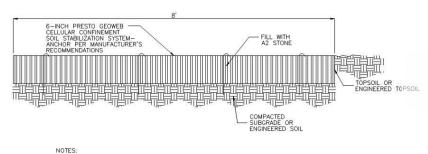


#### **Basin Overflows and Pads**





BIO-FILTRATION GEOWEB OVERFLOW WEIR
N.T.S.



1. LENGTH PER PLANS

BIO-FILTRATION GEOWEB STORM SEWER PAD







#### Basin C-3 - 2018







#### **Final Restoration**









## Basins Complete - August 2013 GRäEF







#### Basin A-1 - 2018

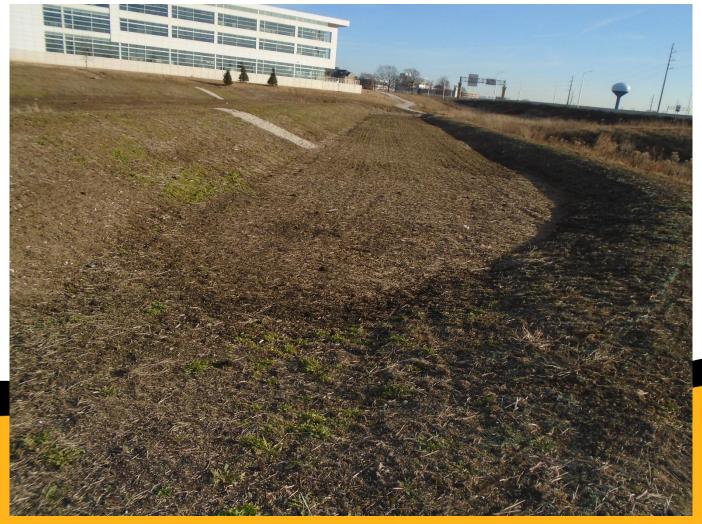








#### Basin D-3 - 2018









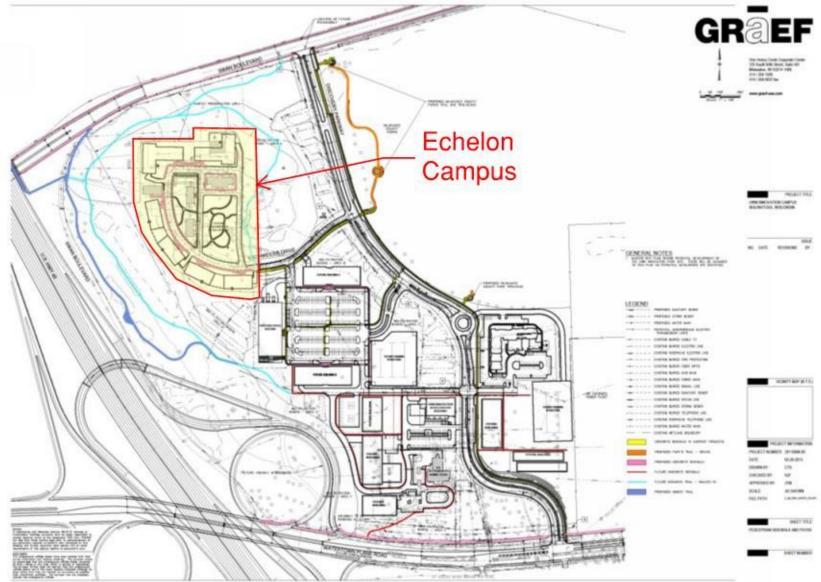
#### Basin E-2 - 2018







#### Echelon – Permeable Pymnt

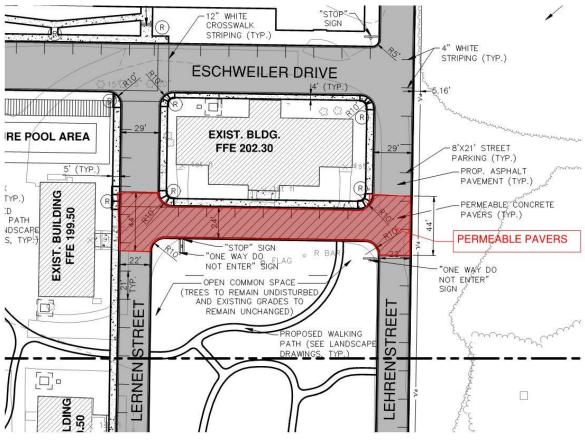








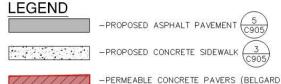
### **Echelon Campus** Permeable Pavement





F IN DECEMBER 2009. ALL UCTURES HAVE BEEN SHOWN CCURACY AND IT SHALL BE IY TO VERIFY THEIR EXACT VOID DAMAGE THERETO.

1 FOR BENCH MARKS. PHIC ELEMENTS. CHALL DE MARKED WITH

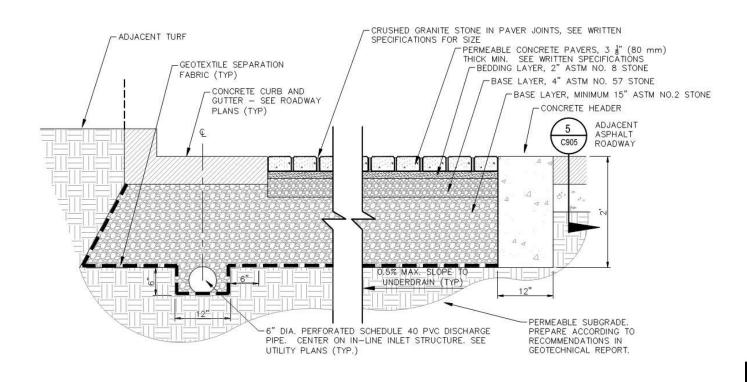


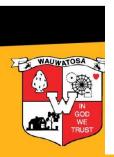
PAVERS)





# Echelon Campus **GRaEF**Permeable Pavement X-Section









REFER TO SITE LAYOUT PLAN FOR LOCATION



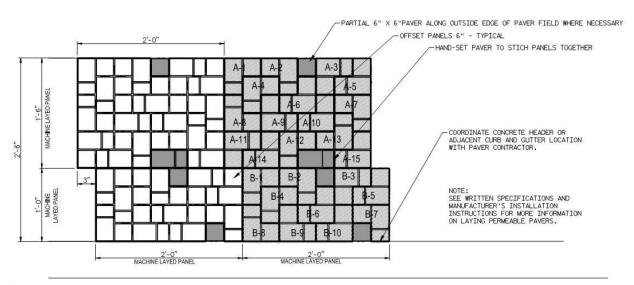
# Echelon Campus Paver Installation – Not per Plan





# Echelon Campus Paver Layout Plan







#### TYPICAL PERMEABLE PAVER LAYOUT PLAN

REFER TO SITE LAYOUT PLAN FOR LOCATIONS.







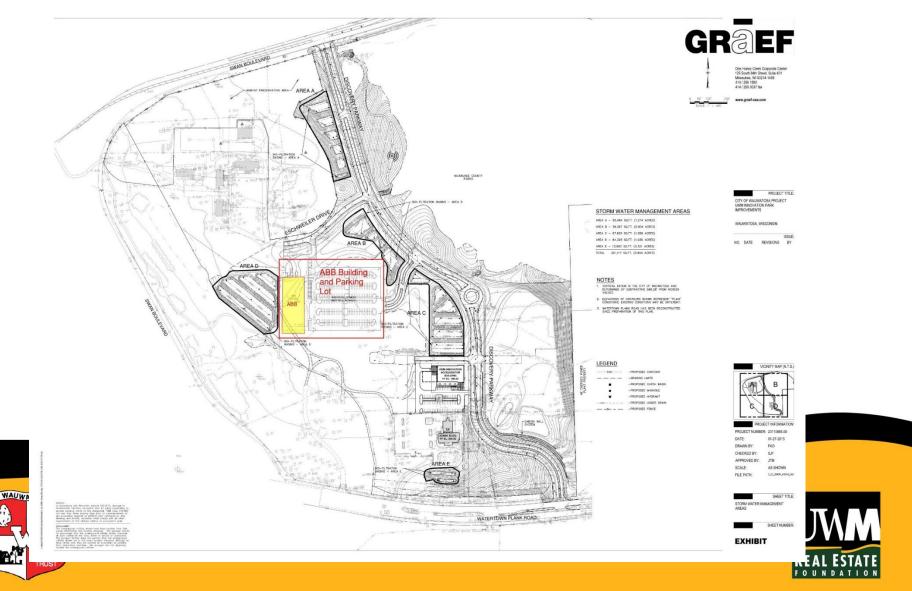
### Permeable Pavers at Echelon Campus





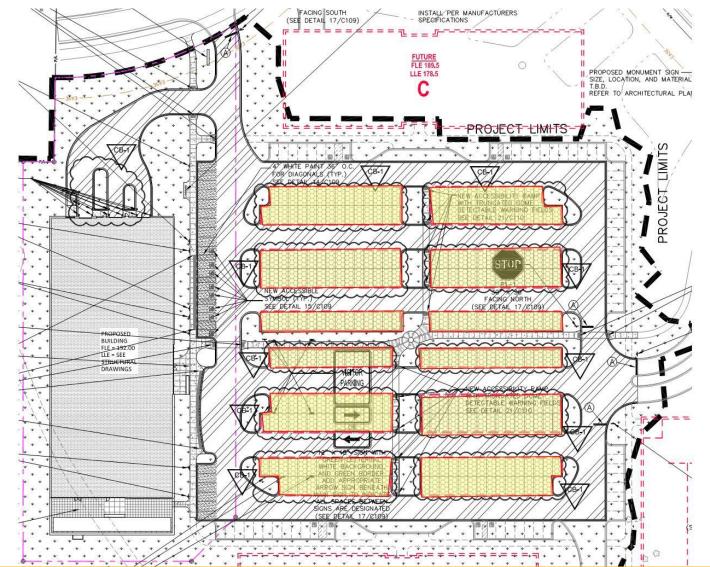
# ABB Building and Parking Lot Permeable Pavement







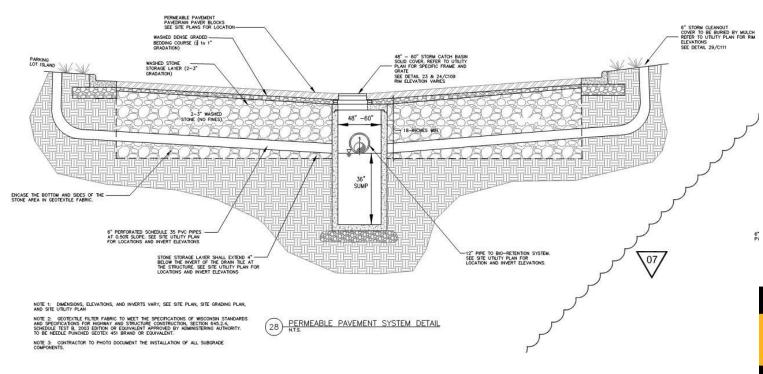
# ABB Parking Lot Permeable Pavement







# ABB Parking Lot **GRaEF**Permeable Pavement X-Section







### Perm Pavers - ABB Parking Lot





### Perm Pavers - ABB Parking Lot



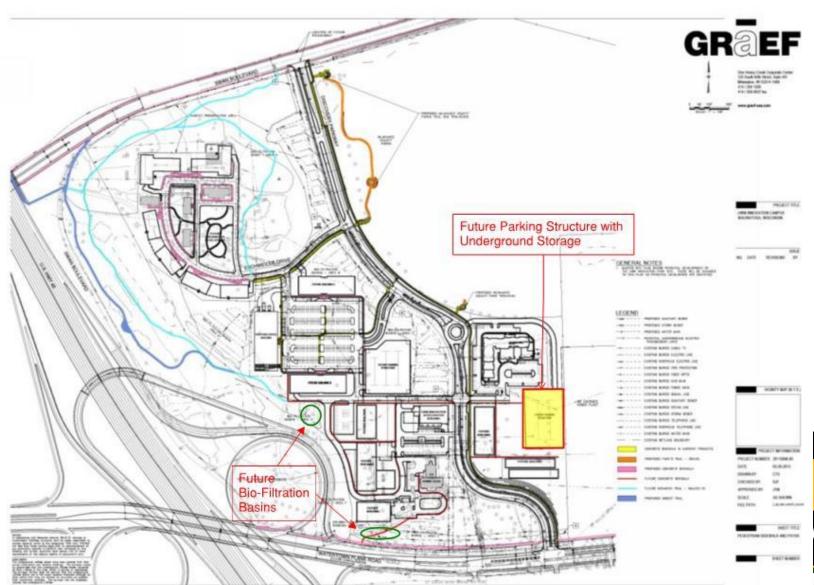


### Perm. Pavers - ABB Parking Lot



### Future BMPs









### What Made This Project "Unique"

- Massive Amount of Stakeholder and Agency Coordination
- Integration of Habitat Preservation with Development
- Implementation of "Zero Discharge" Storm Water Management System
- Public-Private Partnership Between Wauwatosa, UWMRF, and Developer to Work Through Issues Together and Get Things Done







#### Acknowledgements

- Construction Photographs:
  - David Jaeckels, City of Wauwatosa
  - John McCarthy, GRAEF
- Aerial Photography during Construction:
  - Mark Was
- Planning Images and Illustrations:
  - HGA
- ABB parking lot plans
  - Kapur & Assoc.









### QUESTIONS?





